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NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

MBA PROFESSIONAL REPORT

**Defense Travel System (DTS) Airline Ticket Price Analysis:
Do DTS Ticket Prices Differ From Other Online Tickets Available for
Naval Postgraduate School Travelers?**

**By: Alan F. Copeland, and
Dorinda M. Mazza
December 2007**

**Advisors: Douglas A. Brook,
Nayantara D. Hensel**

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DO DTS TICKET PRICES DIFFER FROM OTHER ONLINE TICKETS
AVAILABLE FOR NAVAL POSTGRADUATE SCHOOL TRAVELERS?**

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Submitted in partial fulfillment of the requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION

from the

**NAVAL POSTGRADUATE SCHOOL
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DEFENSE TRAVEL SYSTEM (DTS) AIRLINE TICKET PRICE ANALYSIS: DO DTS TICKET PRICES DIFFER FROM OTHER ONLINE TICKETS AVAILABLE FOR NAVAL POSTGRADUATE SCHOOL TRAVELERS?

ABSTRACT

Study compares airline tickets purchased through the Defense Travel System (DTS) for Naval Postgraduate School (NPS) travelers to prices for similar tickets available at online travel agent (OTA) and carrier websites. The study's purpose is to determine if prices are significantly different and if savings can be achieved by purchasing tickets from different sources. The study finds that DTS tickets are cheaper than carrier refundable tickets, but more expensive than nonrefundable carrier and OTA tickets. Sensitivity analysis indicates nonrefundable tickets would have to average 1.83 and 2.72 changes per ticket, before itinerary changes offset cost savings for nonrefundable carrier and OTA tickets purchased, respectively. Similarly, 26% and 39% of nonrefundable carrier and OTA tickets would have to be canceled to offset saving. Ultimately, this study can help determine if traveler flexibility achieved by purchasing refundable DTS tickets at negotiated "city-pair" rates from carriers is worth the additional cost. This study shows the flexibility achieved through DTS refundable tickets available in the city-pair program comes with a cost; which is the potential savings that could be achieved by using nonrefundable tickets. Annualized, potential savings at NPS could amount as much as \$271,007 if there are no itinerary changes or cancellations.

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I. INTRODUCTION

A. AREA OF RESEARCH

This research looks at Defense Travel System (DTS) airline tickets purchased for Naval Postgraduate School (NPS) travelers and compares these ticket prices to prices readily available through on-line travel agents (OTAs) and carrier websites. DTS is a paperless web-based electronic travel system that allows Department of Defense (DoD) travelers on official business to create travel authorizations (TAs), travel vouchers (TVs) from TAs, and local vouchers. In 1995, the DoD began reengineering efforts to standardize a travel system across services and agencies. DTS is the result of this modernization effort and DoD views it as the standard end-to-end travel system. Its goal is to meet traveler and leadership needs with a seamless, paperless, temporary duty travel (TDY) process. The system reached initial operational capability in 2003 and estimated to attain full operating capability in 2008. This study examines NPS DTS airline ticket costs compared to OTA and carrier website ticket costs and hypothesizes that DTS tickets are more expensive than other available on-line tickets. If DTS tickets are more expensive, estimated losses for DTS tickets could negate DTS processing cost savings benefits. If DTS ticket prices are less expensive than other available tickets, current DTS savings estimates for DoD should be updated to capture these savings.

B. RESEARCH QUESTIONS

The primary research question is: Are the prices of airline tickets purchased for NPS travelers' mission requirements significantly different from comparable tickets available from carrier or OTA websites? The secondary research questions are: (1) Are DTS refundable ticket costs different from carrier refundable tickets costs? (2) Are DTS refundable ticket costs different from carrier nonrefundable tickets? (3) Are DTS refundable ticket costs different from OTA nonrefundable tickets costs? (4) Does the amount of lead-time from ticket purchase to travel departure impact ticket costs for different purchase options? (5) Does sensitivity analysis on estimated frequencies of

NPS air travel itinerary changes and cancellations for DTS refundable tickets reveal cost savings are achievable using OTA nonrefundable tickets, when fees for nonrefundable tickets are considered in total costs?

C. SCOPE OF PROJECT

The scope is limited to NPS airline travel; more specifically, routine TDYs, in CTO booked status without foreign travel using a single carrier to a single TDY destination. Other travel types including foreign travel, invitational travel, emergency travel, and permissive travel are omitted from this study to increase the data standardization and allow more applicability when making comparisons between NPS and normal DoD operating locations.

D. METHODOLOGY

The methodology used consists of a literature review, brief description of general DTS information, data collection and data analysis. The literature review is related to on-line price dispersion. Price differentials are different costs consumers pay for the same or similar products at various internet websites. Airline tickets, as goods available on-line, may be impacted by these differences.

Although this study focuses on DTS airline ticket costs, general DTS information is presented to inform readers about the legacy process and process changes with DTS implementation. This information provides a general backdrop, and better understanding about the system complexities.

This study uses daily data collection for a 45-day period. DTS and on-line identified costs are compared for individual comparable tickets based on routes and times. Additional data criteria are presented in the data collections chapter. Data analysis is conducted using methods accepted and identified in the literature review for on-line price dispersion. Further analysis explanation is provided in the data analysis chapter.

E. STUDY BENEFITS

This study analyzes price differentials for airline ticket prices purchased by NPS travelers using DTS compared to ticket costs readily available through carrier and OTA websites. It will provide foundational information for future DTS analysis and a methodology basis for replication at more traditional DoD operational locations. Dependent on findings, DoD estimated DTS program cost savings may require adjustment. Consequently, this and future studies could potentially benefit DoD by providing opportunities for TDY cost savings and impact future DoD travel policy.

F. CHAPTER OUTLINE

Chapter I introduces DTS and an overview of this project. It covers the study research questions, project scope, study methodology, and closes with potential study benefits. Chapter II provides a literature review of on-line compared to off-line price differentials, on-line price differentials, and then focuses on airline ticket prices and how these price differentials are analyzed in current research. Chapter III gives DTS background increasing reader understanding of this complex travel system. Chapter IV presents data collection methodology for this study, outlining the process and qualifying data selection. Chapter V provides data analysis methodology and analysis answering secondary questions for this project. Chapter VI highlights project findings and addresses the primary question about price differences between DTS purchased airline tickets and similar tickets available at OTA/carrier websites. This chapter also makes recommendations for future study and methodology. It is followed by Chapter VII, where study resources are listed.

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II. LITERATURE REVIEW

A. PRICE DISPERSION

Pan, Ratchford, and Shankar define price dispersion as the price distribution of like items having the same measured characteristics at a given point in time across multiple sellers.¹ These differences can be presented using price ranges or standard deviations. They note that price dispersion is important from consumer, seller, and whole market perspectives. From the market perspective, dispersion is an important information efficiency measure. For sellers, dispersion serves as a reflection of competitive pricing strategy. From a consumer perspective, it indicates alternative offerings of goods and can affect search and purchase behavior.

B. PRICE DISPERSION ON-LINE VS. OFF-LINE

Pan et al., propose there are many reasons for expecting on-line price dispersion to be less than dispersion found off-line; for example, traditional retailing characteristics such as high off-line menu costs resulting in staggered price setting are absent on-line, and should result in lower on-line dispersion.² Bakos indicates lower on-line than off-line internet search costs should suggest reduced price dispersion.³ Brynjolfsson and Smith suggest on-line market entry is significantly easier than off-line due to the simplified website storefront.⁴ Brynjolfsson and Smith also observe e-tailers changing prices more frequently than off-line retailers, but with smaller price change increments.⁵

¹ X. Pan et al., "Price Dispersion on the Internet: A review and Directions for Future Research," *Journal of Interactive Marketing*, 18(4), 116-135, (2004), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=14724404&site=ehost-live&scope=site>.

² Ibid.

³ J. Y. Bakos, "Reducing Buyer Search Costs: Implications for Electronic Marketplaces," *Management Science*, 43(12), 1676-1692, (1997), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=152575&site=ehost-live&scope=site>.

⁴ E. Brynjolfsson et al., "Frictionless Commerce? A Comparison of Internet and Conventional Retailers," *Management Science*, 46(4), 563-586, (2000), <http://web.ebscohost.com/ehost/pdf?vid=3&hid=2&sid=2ed0422e-501d-4594-a9d4-0636618ee705%40sessionmgr8>.

⁵ Ibid.

Pan et al., theorize this reasoning suggests on-line markets should be more competitive, with less price dispersion than conventional markets, but empirical on-line price dispersion research conflicts with this theoretical prediction.⁶

Bailey in Pan et al., find e-tailer price dispersion at least as large as dispersion for traditional retailers for books, music CDs, and software offered through 52 Internet and traditional outlets, using 1996-1997 data.⁷ Bailey also finds higher internet prices for these items compared to purchasing them from available traditional outlets. Pan et al., propose the Bailey findings result from a relatively immature internet market during the Bailey data collection period.⁸

Brynjolfsson and Smith using 1998-1999 data compare on-line and off-line price dispersion for 20 matched book sets.⁹ They find average price ranges of 33% and 25% respectively, indicating dispersion is not narrower on-line compared with off-line. They also find shipping and handling fee inclusion does not significantly alter their results. But, weighing posted retailer prices by respective web traffic visit volume alters their findings indicating dispersion is smaller on-line than off-line. Further, they find on-line prices are lower than off-line, supporting theory of a maturing internet market.

Pan et al., reference several studies by Lee and Gosain, Brown and Goolsbee, and Erevelles, Rolland and Srinivasan, which compare on-line and off-line price dispersion.¹⁰ Lee and Gosain study price dispersion for CDs in February 1999 and January 2000

⁶ X. Pan et al., "Price Dispersion on the Internet: A review and Directions for Future Research," *Journal of Interactive Marketing*, 18(4), 116-135, (2004), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=14724404&site=ehost-live&scope=site>.

⁷ J.P. Bailey, "Intermediation and Electronic Markets: Aggregation and Pricing in Internet Commerce," Unpublished doctoral dissertation, Technology, Management and Policy, Massachusetts Institute of Technology, Cambridge, MA (1998), <http://www.rhsmith.umd.edu/faculty/jbailey/pub/phdthesis.pdf>.

⁸ X. Pan et al., "Price Dispersion on the Internet: A review and Directions for Future Research," *Journal of Interactive Marketing*, 18(4), 116-135, (2004), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=14724404&site=ehost-live&scope=site>.

⁹ E Brynjolfsson et al., "Frictionless Commerce? A Comparison of Internet and Conventional Retailers," *Management Science*, 46(4), 563-586, (2000), <http://web.ebscohost.com/ehost/pdf?vid=3&hid=2&sid=2ed0422e-501d-4594-a9d4-0636618ee705%40sessionmgr8>.

¹⁰ X. Pan et al., "Price Dispersion on the Internet: A review and Directions for Future Research," *Journal of Interactive Marketing*, 18(4), 116-135, (2004), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=14724404&site=ehost-live&scope=site>.

finding no differences between on-line and off-line average of percentage prices.¹¹ Of note though, are product identified category dispersion differences. For instance, for 22 old-hit albums, average price percentage differences are 31% on-line, compared to 11% off-line. But for 21 current-hit albums, differences are smaller at 18% on-line and 19% off-line. This suggests price dispersion levels are related to product characteristics. Brown and Goolsbee investigate internet comparison shopping impact in the life insurance market between 1992 and 1997.¹² They examine individual life insurance policy prices, using hedonic regression controlling for individual and policy characteristics. They find that internet search sites initially had greater price dispersion, which then decreased with increasing internet usage and reduced term life prices by 8-15%. In contrast, Erevelles et al., compare five vitamin industry retail formats exploring pricing behavior comparing on-line to off-line.¹³ They find significantly higher price dispersion on-line than off-line, with average vitamin unit prices higher on-line compared to vitamins at traditional retailers.

This section compares price dispersion findings on-line and off-line. Although theory indicates lower internet search costs, lower on-line market entry, and lower menu costs should reduce on-line price dispersion compared to off-line, studies conflict and fail at providing consensus to substantiate theory. In contrast, greater price dispersion is generally found on-line than off-line.

¹¹ Z. Lee et al., "A Longitudinal Price Comparison for Music CDs in Electronic and Brick-and-Mortar Markets: Pricing Strategies in Emergent Electronic Commerce," *Journal of Business Strategies*, 19(1), 55-71, (2002), <http://proquest.umi.com/pqdweb?did=120629483&Fmt=7&clientId=65345&RQT=309&VName=PQD>.

¹² J. R. Brown et al., "Does the Internet Make Markets More Competitive? Evidence from the life insurance industry," *The Journal of Political Economy*, 110(3), 481-507, (2002), <http://proquest.umi.com/pqdweb?did=122714271&Fmt=7&clientId=65345&RQT=309&VName=PQD>.

¹³ S. Erevelles, et al., "Are Prices Really Lower on the Internet?: An Analysis of the Vitamin Industry," (working paper), Unpublished manuscript, (2001), in X. Pan et al., "Price Dispersion on the Internet: A review and Directions for Future Research," *Journal of Interactive Marketing*, 18(4), 116-135, (2004), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=14724404&site=ehost-live&scope=site>.

C. PRICE DISPERSION ON-LINE

Focusing on the on-line marketplace, Baye, Morgan, and Scholten ask “What accounts for the difference in the levels of price dispersion observed in different on-line markets?”¹⁴ For instance, Brynjolfsson and Smith find on-line differentials around 30% for books and CDs,¹⁵ while Baye et al., cites an Ellison and Ellison working paper finding smaller 5% price differentials for computer memory prices.¹⁶ Baye et al., address this question by proposing two alternatives explaining these differences.¹⁷ First, they explain price dispersion may be a disequilibrium phenomenon being corrected over time. Alternatively, they propose price dispersion could be an equilibrium phenomenon and price differences observed could originate from market structure differences.

1. Price Dispersion as a Disequilibrium Phenomenon

Baye et al., notes the Brynjolfsson and Smith data was collected years before the Ellison and Ellison data.¹⁸ The resulting lower dispersion in the more recent study may reflect prices moving towards a perfectly competitive equilibrium, as customers become more adept using on-line comparison shopping techniques. This explanation is consistent with theory that on-line shopping will lead to a perfectly competitive market equilibrium and low price dispersion.

¹⁴ M. R. Baye et al., “Price Dispersion in the Small and in the Large: Evidence from an Internet Price Comparison Site,” *Journal of Industrial Economics*, 52(4), 463-496, (2004), 463, <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=15275015&site=ehost-live&scope=site>.

¹⁵ E. Brynjolfsson et al., “Frictionless Commerce? A Comparison of Internet and Conventional Retailers,” *Management Science*, 46(4), 563-586, (2000), <http://web.ebscohost.com/ehost/pdf?vid=3&hid=2&sid=2ed0422e-501d-4594-a9d4-0636618ee705%40sessionmgr8>.

¹⁶ G. Ellison et al., “Search, Obfuscation, and Price Elasticities on the Internet” (working paper), Unpublished manuscript, (2001), <http://www.nber.org/papers/w10570>.

¹⁷ M. R. Baye et al., “Price Dispersion in the Small and in the Large: Evidence from an Internet Price Comparison Site,” *Journal of Industrial Economics*, 52(4), 463-496, (2004), 463, <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=15275015&site=ehost-live&scope=site>.

¹⁸ Ibid.

2. Price Dispersion as an Equilibrium Phenomenon

Alternately, Baye et al., propose market structures explain price differences pointing out hundreds of sellers are included in the Ellison and Ellison study, whereas only twenty sellers are in the Brynjolfsson and Smith study.¹⁹ They propose lower dispersion in Ellison and Ellison may stem from more competing sellers.²⁰ To determine if price dispersion as a disequilibrium or equilibrium phenomenon is more relevant, Baye et al., collect four million price observations for 1,000 products found on a leading price comparison website from August 2000 to March 2001.²¹ With this data volume, they quantify the relationship between the numbers of sellers explaining differences in dispersion levels for different products. Baye et al., conclude there is little supporting evidence for price dispersion as a disequilibrium phenomenon being corrected over time.²² Conversely, they find persistent dispersion dependent on market structure. Even with increasing price comparison site usage during their data collection period, statistically significant price dispersion level decreases were absent. But, they do find systematic price dispersion differences related to the number of competitors listing given product prices. For instance, if only two firms offer a product, the price range averages 23%. In contrast, if 17 firms listed prices the gap between the lowest two prices is only 3.5%. Clay, Krishnan, and Wolff also support these findings.²³ Clay et al., investigate book prices for possible on-line price dispersion.²⁴ They study cost differences across firms, product differentiation, and different firm strategies based on consumer behavior types. Clay et al., conclude increased competition results in lower price dispersion and

¹⁹ M. R. Baye et al., "Price Dispersion in the Small and in the Large: Evidence from an Internet Price Comparison Site," *Journal of Industrial Economics*, 52(4), 463-496, (2004), 463, <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=15275015&site=ehost-live&scope=site>.

²⁰ G. Ellison et al., "Search, Obfuscation, and Price Elasticities on the Internet" (working paper), Unpublished manuscript, (2001), <http://www.nber.org/papers/w10570>.

²¹ M. R. Baye et al., "Price Dispersion in the Small and in the Large: Evidence from an Internet Price Comparison Site," *Journal of Industrial Economics*, 52(4), 463-496, (2004), 463, <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=15275015&site=ehost-live&scope=site>.

²² Ibid.

²³ K Clay et al., "Prices and Price Dispersion on the Web: Evidence from the Online Book Industry," *Journal of Industrial Economics*, 49(4), 521-539, (2001), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=6472758&site=ehost-live&scope=site>.

²⁴ Ibid.

that holding competitive structure constant, items advertised more also have lower prices.²⁵ Further, they determine some stores typically offer higher prices at their internet sites than at traditional stores, using internet sites primarily to advertise traditional store locations rather than as primary sales generators.

In this section, on-line price dispersion is discussed as a disequilibrium phenomenon with prices theoretically moving towards equilibrium and as an equilibrium phenomenon with price differences being dependant on market structure. Baye et al., supports the theory that price dispersion is an equilibrium phenomenon related to market structure.²⁶ This indicates lower price dispersion between the two lowest item prices relates to the number of firms offering the item. Greater competition selling a single product results in smaller observed price dispersion between the two lowest prices, but not necessarily in lower overall product price dispersion.

D. PRICE DISPERSION IN THE ON-LINE TRAVEL INDUSTRY

1. Off-line Airline Pricing Power

Airline pricing power is important to on-line travel ticket pricing because off-line airline pricing strategy could impact available on-line OTA/carrier available ticket prices. Borenstein references research indicating airline pricing strategies do not reflect perfect industry competition (for example, Graham, Kaplan, & Sibley, 1983, Bailey, Graham, & Kaplan, 1985, Call & Keeler, 1985, and Morrison & Winston, 1987).²⁷ They report airline route prices increase as an airline increases route concentration between two city-pair locations. Borenstein attempts to outline airline industry market power sources and

²⁵ K Clay et al., "Prices and Price Dispersion on the Web: Evidence from the Online Book Industry," *Journal of Industrial Economics*, 49(4), 521-539, (2001), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=6472758&site=ehost-live&scope=site>.

²⁶ M. R. Baye et al., "Price Dispersion in the Small and in the Large: Evidence from an Internet Price Comparison Site," *Journal of Industrial Economics*, 52(4), 463-496, (2004), 463, <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=15275015&site=ehost-live&scope=site..>

²⁷ S. Borenstein, "Hubs and High Fares: Dominance and Market Power in the U.S. Airline Industry," *RAND Journal of Economics*, 20(3), 344-365, (1989), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=5172519&site=ehost-live&scope=site>.

finds correlations between route concentrations and higher prices.²⁸ He identifies that high average prices charged by some airlines in concentrated markets do not allow all airlines in the market to charge the same higher average prices. Thus some airlines exercise market power, without allowing all airlines to benefit as much. Borenstein finds one market power source for city-pair routes may be the carrier operation size at route endpoints.²⁹ Carriers serving larger traveler proportions traveling from route endpoints than other carriers are more attractive for travelers using these routes. They also tend to have increased traveler usage and higher average route prices on these routes compared with other carriers on the same routes.

Airline competitive advantages can be detailed as either naturally occurring or result from institutions created by airlines.³⁰ Natural advantages result from dominant reputations for offering the most flights to and from cities. Created advantages include frequent-flyer programs enticing members to remain loyal to specific carriers, at the cost of paying premiums for flight to capture the travel miles. Another created advantage is travel agent reward systems paying agent bonuses for favoring specific carriers over others. Computer reservations systems may also provide advantages to some airlines over competitors, based on how these systems list carrier flight data. Lastly, airlines with large operations at crowded terminals may exert power restricting competitor gate and support function access, denying competitor entry or service expansion opportunities at these terminals.

2. On-line Travel Market

Clemons, Hann, & Hitt provide a concise description of the on-line travel market.³¹ They describe airline tickets as complex but clearly describable goods. Direct

²⁸ S. Borenstein, "Hubs and High Fares: Dominance and Market Power in the U.S. Airline Industry," *RAND Journal of Economics*, 20(3), 344-365, (1989), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=5172519&site=ehost-live&scope=site>.

²⁹ Ibid.

³⁰ Ibid.

³¹ E. K. Clemons et al., "Price Dispersion and Differentiation in Online Travel: An Empirical Investigation," *Management Science*, 48(4), 534-549, (2002), <http://proquest.umi.com/pqdweb?did=120982713&Fmt=7&clientId=65345&RQT=309&VName=PQD>.

flight tickets are wholly described by their carrier, departure and arrival terminals and times, price, service class, and restrictions. Tickets that include connections have additional attributes including connection numbers, total connection time, and total trip duration. In the market process, OTAs and carrier websites provide an on-line contact point where travelers can search flights, compare prices, and make travel reservations. These websites collect customer information (like destinations and preferred travel times), add their own parameters, and submit requests to a computerized reservation system that searches for applicable flights. The OTAs then take returned available flight lists, selects a portion of these lists, and sort this list portion for customer display. If a traveler purchases a ticket, the OTA books flights with the reservation system and earns a commission from the gaining airline. OTAs pay a fee to reservation systems for each search request, but are only paid if travelers book tickets. Machlis reports traveler reservation information requests only result in booked travel 1-5% of the time, making targeting shopper segments crucial for boosting purchase probabilities and maximizing profits.³²

Chen describes the on-line travel market, with carrier websites and OTAs competing for travel dollars.³³ With many market competitors, Chen speculates competition should drive down prices, since customers can find on-line sites offering the lowest ticket prices over time and price premiums would be competed away. This hypothesis assumes supplier and customer heterogeneities are absent in the market. If supplier and buyer differences do exist, ticket price differences may remain for tickets marketed for different customer types.

Chen provides potential difference examples.³⁴ For instance, airlines may target different consumer groups at OTAs and websites by providing tickets with different characteristics them. They may also offer bonus frequent-flyer miles for customers using

³² S. Machlis, "Profits Elude Travel Sites," *Computerworld*, 32(1), Dec 29 1997-Jan 5 1998, 53-54, <http://proquest.umi.com/pqdweb?did=25169672&Fmt=7&clientId=65345&RQT=309&VName=PQD>.

³³ J. Chen, "Differences in Average Prices on the Internet: Evidence from the Online Market for Air Travel," *Economic Inquiry*, 44(4), 656-670, (2006), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=22741887&site=ehost-live&scope=site>.

³⁴ Ibid.

their website, frequent-flyer miles, flight confirmations, flight class upgrades, and on-line check-in. These added services may allow airlines the latitude of charging premiums for their website tickets, compared to tickets offered at OTAs. Alternately, OTAs may be able to charge premiums for the additional services they offer which differ from services available at most carrier websites. These services can include travel package deals (i.e. travel, hotel, vehicle rental, and event tickets purchased together), lodging purchases, and rental vehicles. Further, OTAs typically have more flexibility than carriers and can offer travel with multiple stops having each leg booked with a different carrier. This flexibility can potentially reduce overall travel time to some destinations. These added conveniences, may give OTAs pricing power to charge premiums for their unique services.

3. On-line Airline Price Dispersion

Research covering on-line ticket price dispersion is different from most other on-line research focusing on commodity like products such as books or CDs. Ticket differences lie in their multiple ticket quality attributes. Studies investigate the presence of on-line ticket price dispersion with conflicting results.

Clemons et al., emphasize understanding exploitable internet market imperfections and the resulting pricing strategy implications are critical for on-line retailer viability and sellers in markets where consumers are becoming more informed.³⁵ They study OTAs and on-line carrier websites because airplane tickets are complex but fully describable, allowing ticket comparisons with different qualities. Their study of over 900 ticket requests made identically and simultaneously to five OTAs, examining ticket recommendations provided for the request across different ticket characteristics. This study uses 1997 data from a major corporate travel agent for corporate clients, making OTA comparisons under circumstances closely matching how OTAs would be used by actual travelers. They select OTA ticket costs that match their corporate travel requests

based on time-priorities or price-priorities. For time-priorities, tickets within a one-hour departure and arrival window are given preference. If flights are only available within the window for one leg, the departure leg has preference. The cheapest ticket in a given window has preference if more than one flight matches a travel window on a particular trip. For the price-priority criteria, lowest price is the determining factor and tickets falling within the time window are used as tie breakers. To collect data, they used an intelligent agent four days for 24 hours, making between 300 and 500 daily reservation requests. Data was only kept if all OTAs polled returned reservations for requests. Clemons et al., conclude OTA price dispersion averages up to 28% for the same ticket requests.³⁶ Dispersion dropped to 18% when a hedonic price model is used accounting for price variances due to ticket quality differences. These results are also supported by their finding that individual OTAs return tickets inferior to tickets offered by other OTAs from 2.2% to 28% of the time depending on the OTAs being compared.

In contrast to Clemons et al., Chen finds more recent reduced price dispersion.³⁷ Chen questions if competition and market evolution of on-line travel information eliminate price differentials across competing OTAs, or if there are any systematic fare differences from different on-line sites. The study is motivated by changes in the on-line air travel market that may impact price dispersion found in Clemons et al.³⁸ Chen notes OTA usage increased 11-fold from 1997 to 2002, 6 in 10 Americans book air travel on-line, major airlines entered the internet market, and Orbitz entered the on-line competition as a joint venture of several major airlines competing directly with OTAs. Chen compares airline and OTA website ticket prices across 28 different city pairs between Los Angeles and New York City from January 2002 to May 2002 for a total of 3,023 fixed departure date price quotes and 3,373 60-day advance-purchase quotes. Chen

³⁵ E. K. Clemons et al., "Price Dispersion and Differentiation in Online Travel: An Empirical Investigation," *Management Science*, 48(4), 534-549, (2002), <http://proquest.umi.com/pqdweb?did=120982713&Fmt=7&clientId=65345&RQT=309&VName=PQD>.

³⁶ E. K. Clemons et al., "Price Dispersion and Differentiation in Online Travel: An Empirical Investigation," *Management Science*, 48(4), 534-549, (2002), <http://proquest.umi.com/pqdweb?did=120982713&Fmt=7&clientId=65345&RQT=309&VName=PQD>.

³⁷ Ibid.

³⁸ Ibid.

concludes there are little systematic differences in average fare quotes, when tickets are available at multiple on-line sites in 2002 and controlling for ticket availability and other ticket price affecting factors.³⁹ But, when competition is absent, OTAs and carriers charge premiums with higher average prices ranging from 14.1-40.2%. Chen also finds 60 day advance purchases lead to discounted fares and midweek travel is cheaper than other week days.⁴⁰ Chen uses overall result findings generalizing that the on-line travel market is much more competitive in 2002 than in 1997 and premiums charged by major carriers to customers diminish in the presence of increased competition.⁴¹

This section describes several topics that may influence price dispersion of on-line airline tickets. Pricing power of the off-line airline industry may allow some carriers competitive advantages for maintaining airline hub dominance at specific city-pair locations. This advantage allows them to charge premiums for tickets between these locations. The on-line competitive environment is also complex and influenced not only by available ticket attributes, but also different attributes of carrier and OTA websites. Finally, on-line ticket price dispersion is identified in an earlier study, but disputed in a later study when competition is high for specific routes. This change in the on-line market may result from the evolution of the industry as customers become more adapt using on-line searches to find the best ticket prices. But, in the absence of competition, price premiums are again evident.

Discussion of on-line price dispersion leads back to the focus of this study. If dispersion does exist on-line, does it impact DTS tickets purchased compared to OTA and carrier tickets available on-line? Further, does the government win or lose as a result of price dispersion and costs for DTS tickets? The literature indicates that price dispersion exists on-line and the amount of dispersion is not decreasing as the OTA industry matures (grows). This being said, if DTS doesn't access all available sources of

³⁹ J. Chen, "Differences in Average Prices on the Internet: Evidence from the Online Market for Air Travel," *Economic Inquiry*, 44(4), 656-670, (2006), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=22741887&site=ehost-live&scope=site>.

⁴⁰ J. Chen, "Differences in Average Prices on the Internet: Evidence from the Online Market for Air Travel," *Economic Inquiry*, 44(4), 656-670, (2006), <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=22741887&site=ehost-live&scope=site>.

⁴¹ Ibid.

OTA tickets, DoD travelers may not have the opportunity to select the cheapest ticket available for travel. Consequently, DoD travelers may be spending more money than necessary for TDY travel.

III. DTS BACKGROUND

A. GENERAL INFORMATION

“The Defense Travel System is a fully integrated, electronic, end-to-end financial management system that automates temporary duty travel for the Department of Defense. DTS meets unique DoD mission, security and financial system requirements within the guidelines of Federal and DoD travel policies and regulations.”⁴² DTS is broken down into two distinct functions, travel authorization processing and voucher processing.

In 1995, the Reengineering Travel Transition Office identified a need for a change in the DoD travel process. The task force noted seven important areas that unnecessarily complicated the legacy paper travel process. These areas included: “complex statutory and regulatory controls; fragmented elements within the travel system; overly complex and inconsistent business practices; administrative rules focused on stovepipe procedures with no single agency charged with responsibility for total system costs; lack of trust within the system; lack of customer orientation and customer focus; and lack of training and education at all levels.”⁴³

In response to the task force’s findings, the DoD established the Program Management Office Defense Travel System (PMO-DTS) to overhaul DoD’s travel processes to attain greater efficiency by getting rid of multiple DoD TDY systems and processes that were independent, redundant, and included manual processes⁴⁴. As expected, multiple TDY systems are not only costly to maintain but also carry other

⁴² Defense Travel Management Office, “Welcome to the Defense Travel System,” http://www.defensetravel.dod.mil/Sections/DTS_Main.cfm.

⁴³ Defense Travel Management Office, “DTS 101 – Evolution of the Defense Travel System – Updated 1 June 2007,” http://www.defensetravel.dod.mil/Docs/PMO/DTS%20101-Evolution%20of%20DTS_01-June-2007.doc.

⁴⁴ Z E. Gaddy, “Whether the Defense Travel System (DTS) is a Cost Effective Solution for the DoD’s travel needs” Permanent Subcommittee On Investigations, Senate, S. Hrg. 109-246, http://hsgac.senate.gov/_files/STMTGaddyDFASDOD.pdf.

issues such as not being responsive to customer needs, slow reimbursement, and even the potential for fraud, waste, and abuse.⁴⁵

In 1997, the PMO-DTS released a Request for Proposal for “best value travel authorization, commercial travel systems interface, voucher processing and budget tracking system.”⁴⁶ Two offers were received, and in 1998, BDM International, Inc. (BDM) won an eight-year contract (five-year base with three one year renewal options) worth an estimated \$263.7 million. At the time BDM was being acquired by TRW Inc., which was acquired by Northrop Grumman Mission Systems in 2002.

Ideally, PMO-DTS visualized a combination of commercial-off-the-shelf (COTS) software packages and government developed software achieving DTS’s functionality of creating authorizations, reservations, vouchers, and facilitating accounting and disbursing for TDYs.⁴⁷ A major challenge arose trying to integrate 32 defense systems with commercial travel services. Additionally, implementing forthcoming DoD policy requirements for digital signatures and public key infrastructure (PKI) were more difficult than originally predicted.⁴⁸

Development and deployment assumptions originally used to project fielding of DTS were overly optimistic with projected deployment completion by FY2001. Several reviews indicated the projected deployment schedule was unrealistic, leading to contract restructuring in 2002 and establishing a more reasonable baseline schedule and a 2007 project completion estimate. Additionally, DTS was designated as a Major Automated Information System (MAIS) Acquisition Category 1AM.⁴⁹

⁴⁵ Z E. Gaddy, “Whether the Defense Travel System (DTS) is a Cost Effective Solution for the DoD’s travel needs” Permanent Subcommittee On Investigations, Senate, S. Hrg. 109-246, http://hsgac.senate.gov/_files/STMTGaddyDFASDOD.pdf.

⁴⁶ Defense Travel Management Office, “Comparison of the GSA eTravel Service and the DoD Defense Travel System,” http://www.dtstravelcenter.dod.mil/Docs/eTS-DTS_Comparison_Paper_Sep05.pdf.

⁴⁷ Ibid.

⁴⁸ Z E. Gaddy, “Whether the Defense Travel System (DTS) is a Cost Effective Solution for the DoD’s travel needs” Permanent Subcommittee On Investigations, Senate, S. Hrg. 109-246, http://hsgac.senate.gov/_files/STMTGaddyDFASDOD.pdf.

⁴⁹ Ibid.

The Defense Acquisition 5000 series acts as a guide for DoD's acquisition processes. Because DTS was a special interest item and due to its extensive concept refinement and technology development work that had already been accomplished, DTS entered the formal DoD acquisition process at the Post-Milestone B phase. However, the program did not escape a lengthy technical, functional, and financial analysis that extended through 2003. "This extensive effort involved the active participation by the Military Services, the Defense Agencies, and the Office of the Secretary of Defense (OSD) staff, along with GSA eTravel program management office consultation."⁵⁰

The DoD completed a follow-on comparative cost analysis before reaching a full rate deployment (Milestone C) decision. This study proved that DTS was cost advantageous to the Department and was one of the many aspects considered in making the DTS full rate deployment (Milestone C) decision. "With Military Service and Major Defense Agency concurrence, DTS was formally approved in December 2003 for full scale spiral development and implementation throughout the Department during the FY04 to FY06 timeframe."⁵¹

B. DTS TRAVEL AUTHORIZATION/VOUCHER PROCESS

DTS allows DoD travelers to create travel authorizations (TA), travel vouchers (TV) from authorizations, and local vouchers for official government travel. This chapter provides general process information about the defense travel system prior to DTS, the current DTS process, describes Defense Travel Administrators (DTAs) that facilitate the DTS travel process, the TA process, and the TV process steps.

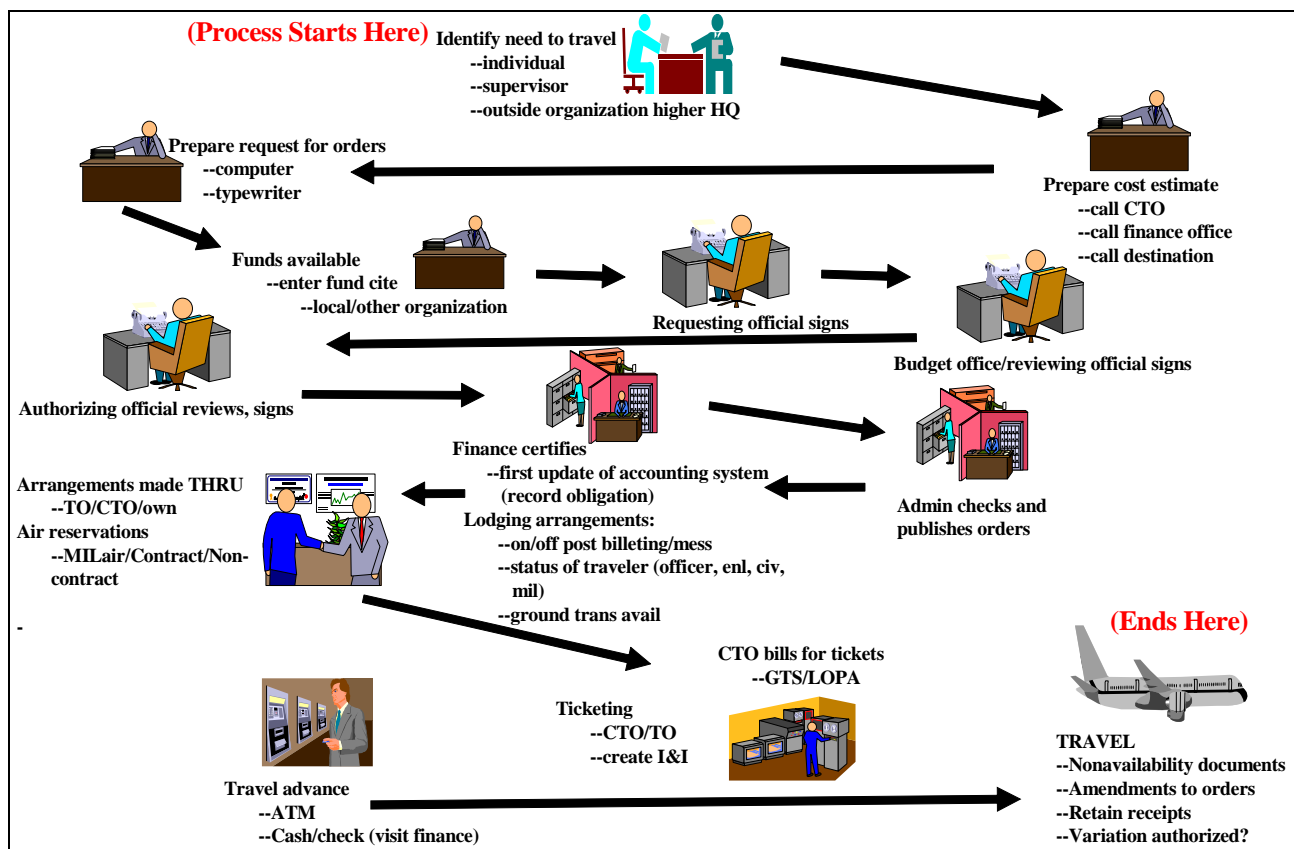
As has been report by the Government Accountability Office (GAO), DTS has its issues, but the business process that DTS replaced (the paper travel order and voucher processing procedure) was very labor intensive and included many steps. Figures 1 and 2 illustrate the pre-DTS travel order and voucher processes. DTS streamlines the process

⁵⁰ Defense Travel Management Office, "Comparison of the GSA eTravel Service and the DoD Defense Travel System," http://www.dtstravelcenter.dod.mil/Docs/eTS-DTS_Comparison_Paper_Sep05.pdf.

⁵¹ Ibid.

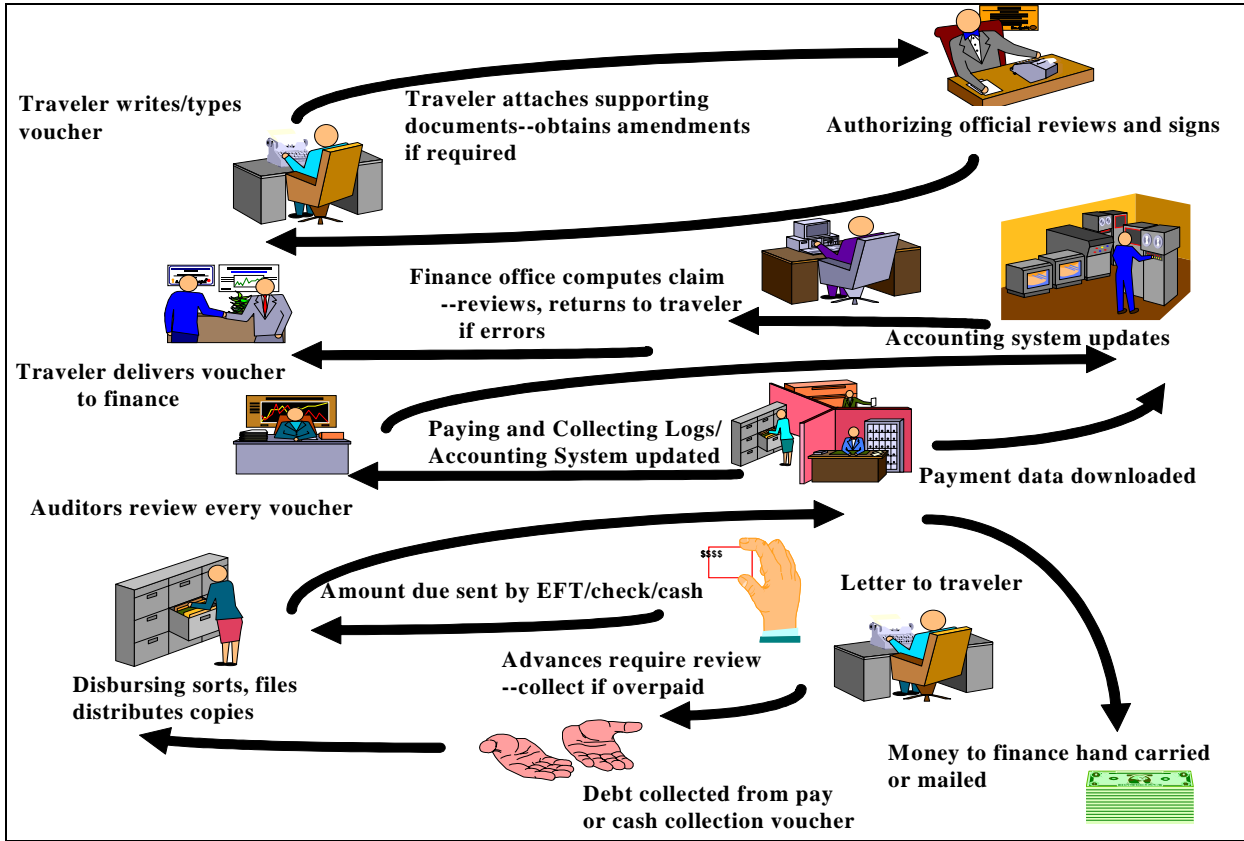
for more efficient travel order and voucher processing. Figures 3 and 4 depict the post-DTS travel authorization and voucher processes. DTS improves business processes because of the value added from a personnel perspective. Some personnel benefiting from DTS include Financial Management (FM) technicians, organizational travel clerks and most importantly, the traveler.

Figure 1. Pre-DTS Travel Authorization Process ⁵²



⁵² Defense Travel Management Office, "Training Materials – Introduction, Current Pre-Travel Process," http://www.defensetravel.dod.mil/Training/DTS/Docs/TrnMat/DTS_LSN1.ppt#421,7, Current Pre-Travel Process.

Pre-DTS Travel Voucher Process ⁵³



⁵³ Defense Travel Management Office, “Training Materials – Introduction, Current Post-Travel Process,” http://www.defensetravel.dod.mil/Training/DTS/Docs/TrnMat/DTS_LSN1.ppt#439,9,Current Post-Travel Process.

Figure 3. DTS Travel Authorization Process ⁵⁴

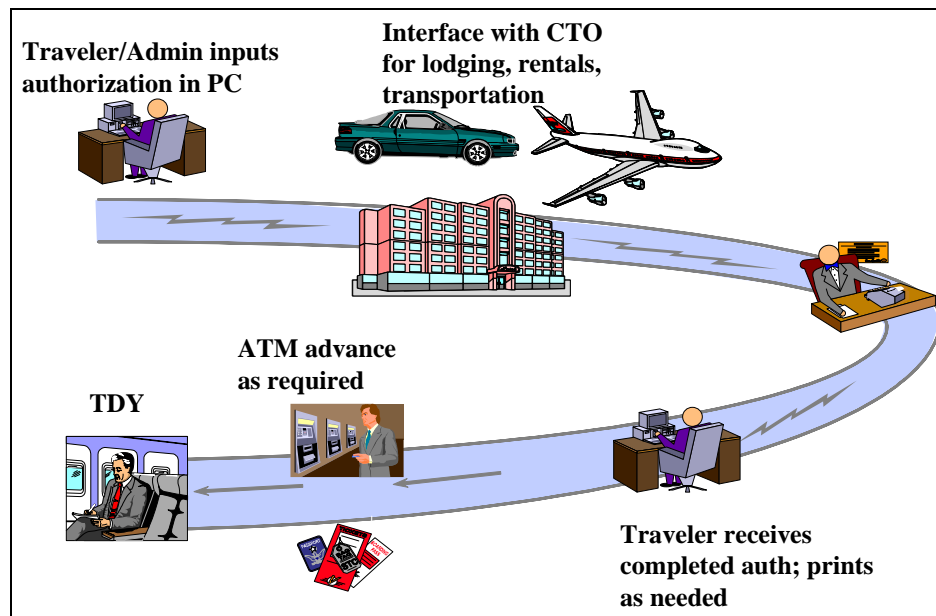
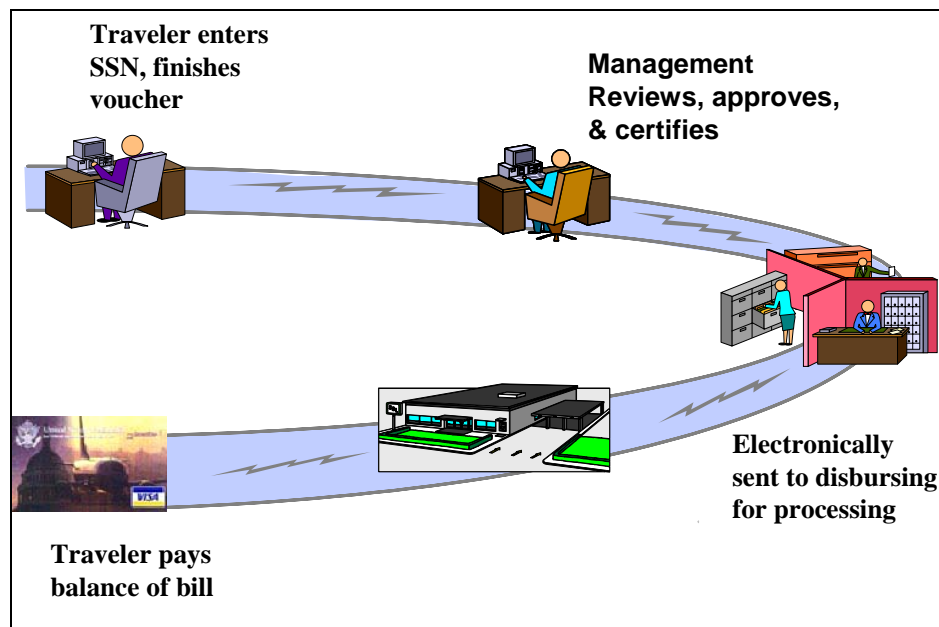


Figure 4. DTS Travel Voucher Process ⁵⁵



⁵⁴ Defense Travel Management Office, "Training Materials – Introduction, DTS Authorization Process," http://www.defensetravel.dod.mil/Training/DTS/Docs/TrnMat/DTS_LSN1.ppt#422,8, DTS Authorization Process.

⁵⁵ Defense Travel Management Office, "Training Materials – Introduction, DTS Voucher Process," http://www.defensetravel.dod.mil/Training/DTS/Docs/TrnMat/DTS_LSN1.ppt#424,10, DTS Voucher Process.

Prior to DTS, the business process from one Air Force base perspective for the FM technicians was very tedious. Before the travel, the technician had to review the authorization to ensure the organization noted the right line of accounting and ensure that the organization had money available for travel.⁵⁶ Once this information was verified, the technician would then assign an authorized travel authorization number. After the travel occurred, the travel voucher and receipts were forwarded to the technician.⁵⁷ The technician verified the expenses claimed and ensured all applicable receipts were present. The voucher was then forwarded to another technician who entered the information into a legacy accounting system so the traveler is paid. The travel voucher is then forwarded to another technician for the audit process, ensuring that what is stated on the voucher was entered into the accounting system correctly. DTS changed the FM business process by eliminating FM from the travel order or voucher processing process. All of the FMer's duties have been transferred to the organization. From an FM technician's point of view, this allows the remaining, limited number of personnel to focus on other FM customer service duties.

Organizational travel clerks are also affected by the introduction of DTS. Prior to DTS, organizational travel clerks were responsible for not only arranging all the details of the travel but also preparing both the travel order and travel voucher. Depending on the number of travelers and frequency of travel in the organization, this could be a full time job. Another aspect of preparing the travel orders and vouchers was the form would not save with the traveler's information, so if an error was found after closing and printing the document, the entire document would have to be retyped. DTS pushed all this responsibility on to the traveler, which freed up the clerk for other organization duties. Additionally, DTS makes it easier to file a voucher by maintaining the estimated travel expenses in the system.

⁵⁶ Defense Travel Management Office, "Training Materials – Introduction, Current Pre-Travel Process," http://www.defensetravel.dod.mil/Training/DTS/Docs/TrnMat/DTS_LSN1.ppt#421,7,Current Pre-Travel Process.

⁵⁷ Defense Travel Management Office, "Training Materials – Introduction, Current Post-Travel Process," http://www.defensetravel.dod.mil/Training/DTS/Docs/TrnMat/DTS_LSN1.ppt#439,9,Current Post-Travel Process.

Travelers benefit from DTS because they are in charge of their own travel arrangements. In some pre-DTS cases, the traveler called the contracted travel office for travel arrangements and took their recommendations for the best flights, hotels, and rental cars available. With DTS, the traveler sees flights, hotels, and rental cars available and can pick ones that work best with their itinerary. In addition, travelers are paid faster post-DTS because of the electronic approvals and interfaces. Prior to DTS, the traveler had to wait until the paper document was signed by all approval authorities and wait for an FM technician to enter the data into a legacy accounting system.

1. Travel Authorizations

This section outlines general travel authorization process steps.

Step 1: Traveler identifies a TDY requirement.

Step 2: Traveler opens DTS and starts the TA request. Concurrently, DTS interfaces with the Commercial Travel Office (CTO) for lodging, rental, and transportation information which becomes immediately available to the traveler. The traveler submits the TA request and DTS notifies an Authorizing Official (AO) of a request awaiting approval.

Step 3: AO logs into DTS and approves the TA request, changes the TA, sends it back to the traveler for changes, or cancel the request.

Step 4: If approved, the TA request becomes a TA and is returned to DTS where a travel authorization number is attached, budgets are updated, CTO issues an e-ticket, and the TA is returned to the traveler.

Step 5: The traveler gets email notification of the TA return and can print the e-ticket. The traveler is also authorized to obtain ATM advances and is ready for TDY.

2. Travel Vouchers

Prior to DTS, the voucher processing system was very cumbersome, as depicted previously in Figure 2.⁵⁸ It could take up to four (plus) weeks for a voucher to be processed and paid. Since the implementation of DTS, the voucher processing system has been streamlined whereby the traveler only has to update estimated expenses originally detailed in his/her travel authorization. The streamlined process was again previously shown in Figure 4.⁵⁹ The travel voucher process steps are detailed below.

Step 1: First logging onto DTS with a Common Access Card (CAC), the traveler selects the travel authorization that he/she would like to create a voucher from. This will automatically bring up the traveler's authorization which includes details of the TDY, such as the itinerary, reservations, and estimated expenses. While changes the traveler's itinerary, travel reservation (air, lodging, rental car), and line of accounting are important, the critical changes must be made within the expense category.

Step 2: In the expense tab the traveler can add, remove or amend the estimated expenses originally detailed in the travel authorization. Additionally, the traveler can link to his/her GTC which shows all pending charges that have posted to the Bank of America system. The traveler can add reimbursable expenses from their GTC to their voucher. The traveler must also remember to add any other authorized reimbursable expenses, such as hotel sales taxes.

Step 3: Once all expenses have been accurately accounted for, the traveler must upload substantiating records. For voucher processing, substantiating records are receipts for any expense over seventy-five dollars. The traveler uploads appropriate receipts via fax or scanner. When using the fax, the traveler prints off a fax cover sheet that corresponds only to that voucher. The fax cover sheet and receipts are faxed to a DTS system that uploads the receipts to that particular voucher.

⁵⁸ Defense Travel Management Office, "Training Materials – Introduction, DTS Authorization Process," http://www.defensetravel.dod.mil/Training/DTS/Docs/TrnMat/DTS_LSN1.ppt#422,8,DTS Authorization Process.

⁵⁹ Defense Travel Management Office, "Training Materials – Introduction, DTS Voucher Process," http://www.defensetravel.dod.mil/Training/DTS/Docs/TrnMat/DTS_LSN1.ppt#424,10,DTS Voucher Process.

Step 4: Next, the traveler should review the options to ensure the GTC is paid in full, also known as split disbursement. The traveler has the option to add more funds to the payment scheduled for the GTC, ultimately reducing the amount paid to the traveler and paying off the GTC balance.

Step 5: After taking care of his/her GTC, the traveler needs to address pre-audit flags that arise from any updates made during the voucher process. Pre-audit flags tie directly to the JFTR for uniformed members and the JTR for civilian personnel; these two regulations govern DoD travel. After an explanation for the pre-audit flags is entered, the traveler signs the voucher. The voucher is electronically submitted through the routing process, ultimately to the Approving Official (AO).

Step 6: Lastly, the responsibility is now shifted to the AO. The AO is notified that a voucher is waiting approval through an automated email. When the AO electronically receives a voucher, he/she must scrutinize the expenses claimed by the traveler. Some basic questions an AO would ask include:

- Where all actual reimbursable expenses claimed?
- Was the mode of travel consistent with the travel authorization?
- If long distance calls were claimed, were they authorized?
- Did the traveler claim gasoline and prepaid gas?
- Did the traveler claim hotel taxes?
- Are GTC charges split disbursed?
- Did the traveler account for meals provided?
- Are required receipts attached to the voucher?

Once the AO reviews the voucher, he/she either approves/signs or returns the voucher. If the AO disapproves any expenses, he/she should electronically stamp the voucher RETURNED and explain what corrections are necessary. The returned process forwards the voucher to the traveler so corrections can be made. When the voucher is

approved and stamped SIGNED, it passes through a few electronic interfaces, including the accounting system, the pay system, and the GTC system, for payment.

If the traveler fails to submit a voucher within 5 days of returning from TDY as per the travel regulations, the DTA can run unsubmitted voucher reports that will automatically send an email to the traveler reminding them of their responsibility to file a voucher.

This section provided process steps for the DTS TA and TV processes as well as general information and functions that support the system. Although the creation of authorizations and vouchers may seem simple from a top level view, they are relatively complex when looking at all the initial and supporting information required for travel, as well as multiple entities involved in the process besides the traveler. But, the process can be efficient and the authorization process can be accomplished in less than an afternoon if the traveler and AO are available and experienced with DTS. While the DTS voucher processing system is certainly more streamlined and efficient than the paper TDY voucher processing system, there is a learning curve and a process change associated with the new on-line travel system. As a result of the DTS voucher process, travelers now get paid a few days after their final voucher is processed, as opposed up to four weeks for the old process. Travelers and AOs alike must be familiar with how DTS operates to gain full functionality of the system. This system provides a huge benefit over previous paper-based TA methods employed by DoD with much longer process times, more steps, and included transportation and waiting times for processing paper documents.

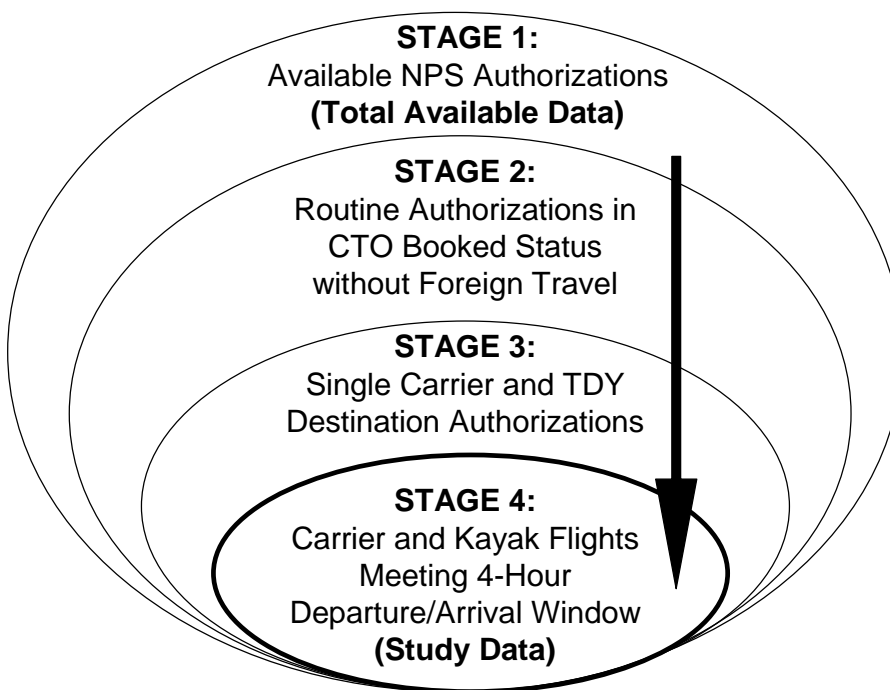
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IV. DATA COLLECTION

A. COLLECTION METHODOLOGY

Data collection methodology in this study was a variation on the Clemons et al., study previously discussed in Chapter II, D.3.60 Data collection involved retrieving relevant NPS DTS travel transactions and recording those transactions from the DTS system. Travelers were either NPS personnel or individuals traveling using NPS funds and routed through NPS. Potentially relevant data started with all travel authorizations available in DTS and was filtered at different stages to more accurately identify data points for price comparison. Figure 5 illustrates the four data filter levels used to identify data for this study:

Figure 5. Data Filter Process



⁶⁰ E. K. Clemons et al., "Price Dispersion and Differentiation in Online Travel: An Empirical Investigation," *Management Science*, 48(4), 534-549, (2002), <http://proquest.umi.com/pqdweb?did=120982713&Fmt=7&clientId=65345&RQT=309&VName=PQD>.

Stage 1: At the top filter level, all NPS authorizations available in DTS were pulled daily from noon on the previous business day to noon on the current day. For example, if today is Tuesday, data was pulled Monday to noon on Tuesday. On Monday, data was pulled starting at noon on Friday.

Stage 2: The large Stage 1 was filtered for increased study relevancy at this stage. Relevant data consisted of routine TDY transactions; excluding travel ticket costs for invitational travel and emergency leave travel orders. These items are excluded to more accurately relate ticket expenses to mission operations. Authorizations also had to be in the CTO booked status and not include foreign flag carriers. Authorizations had to be in CTO booked status because DTS reserved ticket prices at this point and it was the closest DTS stage where ticket prices could be identified for comparisons. This was important because it more accurately allows comparison of DTS prices with on-line available ticket prices. Authorizations with foreign flag carriers were eliminated because they would have added multiple carriers to travel and skew DTS and carrier ticket price comparisons. Overall, collection efforts at this filter level yielded 202 potential travel authorizations for further consideration.

Stage 3: Starting with these 202 Stage 2 line items, each authorization was individually inspected to determine if it met our research criteria. More specifically, authorizations with multiple carriers, multiple TDY destinations, or did not have air travel were eliminated. Authorizations with multiple carriers or TDY locations were eliminated because they again did not facilitate price comparisons with OTA carrier websites. This filter eliminated 49 authorizations for failing to meet research criteria and left 153 potential authorizations in the research pool.

Stage 4: While researching price data online, 29 authorizations did not meet our four-hour window criteria. When comparing flights, a four-hour flight window (departure and arrival) was used and the lowest cost ticket available was selected for comparison with DTS cost data. This window (two hours prior to DTS ticket flight departure to two hours after departure) was used to identify the lowest cost tickets available for study inclusion. This four-hour window was used for comparison because this study presumes travelers selected travel itineraries based on mission requirements and not solely on ticket

costs. For instance, a traveler with an early morning departure may need to arrive for an afternoon obligation at their TDY destination. Conversely, a late departure may imply a morning obligation prior to travel. Final collection efforts yielded 124 authorizations for comparison for the period of 11 July 2007 to 24 August 2007.

B. COLLECTION PROCESS STEPS

A list of data collection steps is provided below to allow duplication of collection procedures. Price changes during the day impacting this study.

- 1.** At 1200 each week day, run Signed Status report from the DTS report database for previous and current day
- 2.** Delete Traveler SSN
- 3.** Filter on Trip Type and delete trips if not AA-ROUTINE TDY/TAD
- 4.** Filter on status and delete records if status if not CTO BOOKED
- 5.** Filter on Foreign Flag and delete records that contain a foreign flag carrier
- 6.** Go to DTS "Official travel-Others" and pull each travel document by traveler name
- 7.** Record document and extract flight information (Carrier, Travel departure/destination locations and times, ticket costs)
- 8.** Go to carrier website for the carrier identified on each DTS travel authorization
- 9.** Identify nonrefundable/refundable flights according to search criteria and record the lowest applicable ticket costs
- 10.** Go to Kayak.com and identify flights fitting original travel document criteria (within travel window) and record lowest applicable cost

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V. DATA ANALYSIS

A. ANALYSIS METHODOLOGY

Data were analyzed for comparisons between DTS refundable ticket prices with OTA carrier refundable and nonrefundable ticket prices, and nonrefundable Kayak prices. Refundable ticket itineraries can be changed or cancelled without any additional traveler fees. Nonrefundable ticket itineraries can normally be changed with incurrence of an additional change fee for the traveler. These change fees vary, but are usually \$100 per change. Kayak is an OTA travel search engine accessing hundreds of travel sites around the world and providing information for travelers in an easy-to-use display and sending travelers to these sources for purchases. Kayak is used as a representative online search engine, like several others available and providing similar services like Mobissimo (mobissimo.com) and Farecast (farecast.com). Kayak inclusion in this study does not indicate it is the cheapest, most comprehensive, or most representative. A list of carrier and Kayak websites used in this study is provided at Chapter VII.

B. DTS TICKET PRICE COMPARISONS

Table 1 compares DTS total and average ticket costs to comparison categories used in this study. For the 124 DTS tickets identified for comparison, NPS expended a total of \$87,758 at an average ticket price of \$708 from 11 July 2007 to 24 August 2007. Findings suggest refundable DTS tickets on average are cheaper than OTA carrier refundable tickets. Further, nonrefundable tickets are less expensive than refundable DTS tickets, with Kayak tickets being least expensive.

Table 1. DTS Ticket Cost Comparison

DTS Ticket Cost Comparison				
Sample Size: 124				
Time Frame Captured: 11 July to 24 August 2007				
	Refundable DTS Tickets	Refundable Carrier Website Tickets	Nonrefundable Carrier Website Tickets	Nonrefundable Kayak Tickets
Total Ticket Cost	\$ 87,758	\$ 119,078	\$ 65,117	\$ 53,882
Total Cost Difference		\$ (31,320)	\$ 22,641	\$ 33,876
Avg Ticket Cost	\$ 708	\$ 960	\$ 525	\$ 435
Avg Cost Difference		\$ (253)	\$ 183	\$ 273
Annualized Saving		\$ (250,560)	\$ 181,130	\$ 271,007
		DTS cheaper	DTS more expensive	DTS more expensive

When compared to refundable carrier website tickets, refundable DTS tickets are on average \$253 cheaper, costing a total of \$31,320 less than refundable carrier tickets identified. However, when compared to nonrefundable carrier website and Kayak tickets, refundable DTS tickets are on average \$183 and \$273 more expensive, respectively. In total, nonrefundable carrier and Kayak website tickets were \$22,641 and \$33,876, respectively, less expensive than DTS tickets. Annualized, DTS saves \$250,560 compared to carrier refundable tickets and costs \$181,130 and \$271,007 more than carrier nonrefundable and Kayak tickets, respectively. But, the nonrefundable carrier and Kayak comparisons do not consider change fees or cancellation costs that would be incurred resulting from these tickets.

To determine if price differences were significant, a regression analysis was performed. Using DTS as the base comparison for regression analysis, Table 2 indicates differences are significant at a .05 significance level for carrier refundable and nonrefundable, as well as Kayak tickets. The overall regression model was also significant and answers our primary research question by confirming that DTS tickets prices are different than other available OTA tickets. It also answers several secondary questions about specific types of tickets, concluding that DTS tickets are more expensive than carrier nonrefundable and Kayak tickets and less expensive than carrier refundable tickets.

Table 2. DTS Base Case Regression Analysis

<i>Regression Statistics</i>					
Multiple R	0.5161				
R Square	0.2663				
Adjusted R Square	0.2618				
Standard Error	334.8149				
Observations	496				
ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	3	20019543.12	6673181.041	59.53	7.58E-33
Residual	492	55153685.52	112100.99		
Total	495	75173228.64			
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	
Intercept	707.73	30.07	23.54	1.28E-82	
Carrier Refundable	252.58	42.52	5.94	5.39E-09	
Carrier Nonrefundable	-182.59	42.52	-4.29	2.11E-05	
Kayak	-273.19	42.52	-6.42	3.12E-10	

C. PURCHASE DATE/DEPARTURE DATE COMPARISON

The tickets identified for the study were grouped based on the number of days between purchase date (CTO booked) and departure date, per Table 3. Stratification yielded 15 tickets purchased with 7 days or less, 22 purchased 8 to 14 days prior to travel, 50 purchased 15 to 30 days before travel, and 37 purchased more than 30 days from the travel date.

Table 3. DTS Purchase Date to Departure Date Price Comparison

Purchase Date to Departure Date Price Comparison					
	Average Price of Ticket				
Traveling w/in	DTS	Carrier Refundable	Carrier NonRefundable	Kayak	# Tickets in study
7 Days or Less	\$ 689	\$ 974	\$ 788	\$ 603	15
Avg Cost Diff		\$ (285)	\$ (99)	\$ 86	
8 to 14 Days	\$ 723	\$ 985	\$ 583	\$ 471	22
Avg Cost Diff		\$ (261)	\$ 140	\$ 252	
15 to 30 Days	\$ 677	\$ 947	\$ 484	\$ 405	50
Avg Cost Diff		\$ (269)	\$ 193	\$ 272	
>30 Days	\$ 747	\$ 958	\$ 440	\$ 384	37
Avg Cost Diff		\$ (211)	\$ 307	\$ 363	

Findings suggest that DTS is always cheaper on average than purchasing refundable tickets from the same carrier used for DTS travel. Purchasing with shorter lead times to departure increase the economical value of DTS tickets compared to carrier refundable tickets, ranging from \$211 cheaper when over 30 days advance purchase to \$285 cheaper on average when purchased 7 days or less prior to departure. When purchasing tickets with less than 7 days to departure date, Kayak is the only option that provides the cheapest nonrefundable ticket by \$86 on average per ticket; whereas refundable carrier and nonrefundable carrier tickets are more expensive than refundable DTS tickets, on average by \$285 and \$99, respectively. If purchasing tickets beyond 7 days to departure date, carrier nonrefundable and Kayak tickets are progressively cheaper than DTS tickets, from \$140 and \$252 at 8 to 14 days and \$307 and \$363 respectively.

To determine if the time from purchase date to departure date is significant, date ranges were added to the regression model previously discussed in Table 2, which determined that price differences by ticket purchase type were significant. Table 4 uses DTS as the ticket purchase type and less than 7 days from purchase date to departure date as base comparisons for an open regression analysis. As in Table 2, Table 4 indicates differences are significant at a .05 significance level for carrier refundable and nonrefundable, as well as Kayak tickets. Further, the regression indicates that time to departure ranges from 8 to 14, 15 to 30, and greater than 30 are significantly less expensive than tickets purchased less than 7 days to departure. The overall regression model is also significant and accounts for 28.0% of variability in the data when controlling for ticket purchase method and days to departure. Adding days to departure improves on the previous regression at Table 2, which only accounted for 26.6% of the data variability. This model again answers our primary research question by confirming that DTS tickets prices are different than other available OTA tickets, as well as a secondary question about the impact of time from purchase to departure significantly impacting ticket purchase prices.

Table 4. DTS and <7 Day Base Case Regression Analysis

<i>Regression Statistics</i>					
Multiple R	0.5292				
R Square	0.2801				
Adjusted R Square	0.2712				
Standard Error	332.6766				
Observations	496				
ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	6	21053781.11	3508963.52	31.71	3.10E-32
Residual	489	54119447.53	110673.72		
Total	495	75173228.64			
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	
Intercept	814.24	50.1394	16.24	9.59E-48	
Carrier Refundable	252.58	42.2500	5.98	4.35E-09	
Carrier Nonrefundable	-182.59	42.2500	-4.32	1.88E-05	
Kayak	-273.19	42.2500	-6.47	2.44E-10	
8-14	-72.74	55.6976	-1.31	1.92E-01	
15-30	-135.01	48.9687	-2.76	6.05E-03	
>30	-131.28	50.9152	-2.58	1.02E-02	

D. SENSITIVITY ANALYSIS

As noted above, if NPS travelers require refundable air fares, then it is more advantageous to purchase DTS refundable tickets rather than carrier refundable tickets. However, if travelers can purchase nonrefundable tickets, it can be more cost effective than using DTS, except in cases of traveling within 7 days booking travel using carrier nonrefundable tickets. DTS does not capture change or cancellation frequencies. Therefore, for study purposes, points where itinerary changes and cancellation costs offset benefits of using nonrefundable or Kayak purchased tickets in Tables 5 and 6. For instance, how often would tickets have to be changed (incurring fees) to lose the \$22,641 and \$33,876 savings identified in Table 1 for nonrefundable carrier and Kayak tickets, respectively are identified in Table 5. Table 6 identifies how often tickets would have to be cancelled to lose the same benefit.

1. Change Fee Sensitivity Analysis

Sensitivity analysis in Table 5 hypothesizes the cost savings if nonrefundable tickets were purchased and had to be changed, presuming a \$100 change fee.

Table 5. DTS vs Carrier/Kayak Change Fee Sensitivity Analysis

DTS vs Carrier/Kayak Change Fee Sensitivity Analysis (% tickets with 1 change at \$100 per change)							
Total Costs Traveling w/in	DTS	Carrier NonRefundable			Kayak NonRefundable		
		0%	183%	273%	0%	183%	273%
7 Days or Less DTS Diff	\$10,332	\$11,815 (\$1,483)	\$14,554 (\$4,222)	\$15,913 (\$5,581)	\$9,047 \$1,285	\$11,786 (\$1,454)	\$13,145 (\$2,813)
8 to 14 Days DTS Diff	\$15,915	\$12,828 \$3,086	\$16,846 (\$931)	\$18,839 (\$2,924)	\$10,373 \$5,542	\$14,390 \$1,525	\$16,383 (\$469)
15 to 30 Days DTS Diff	\$33,873	\$24,199 \$9,674	\$33,329 \$544	\$37,859 (\$3,986)	\$20,267 \$13,607	\$29,397 \$4,477	\$33,927 (\$53)
> 30 Days DTS Diff	\$27,638	\$16,275 \$11,363	\$23,031 \$4,607	\$26,383 \$1,255	\$14,196 \$13,442	\$20,953 \$6,686	\$24,305 \$3,333
TOTAL COST	\$87,758	\$65,117	\$87,759	\$98,994	\$53,882	\$76,525	\$87,759
TOTAL SAVINGS		\$22,641	(\$1)	(\$11,236)	\$33,876	\$11,233	(\$1)
ANNUALIZED SAVINGS		\$181,130	(\$9)	(\$89,884)	\$271,007	\$89,868	(\$7)

For carrier nonrefundable tickets, sensitivity analysis indicates, 183% of purchased tickets or each ticket would have to be changed 1.83 times before the cost-benefit of using carrier OTAs drops close \$0. If carrier nonrefundable tickets are changed more than 1.83 times each, the use of carrier nonrefundable tickets results in a loss, compared to DTS. For instance, at 273% or 2.73 changes per ticket, carrier nonrefundable tickets cost \$89,884 more than using DTS. For Kayak purchased tickets, since Kayak nonrefundable tickets are on average less expensive than carrier nonrefundable tickets, 273% of Kayak tickets or 2.73 changes per ticket would offset the benefit of using this OTA source. Change rates exceeding 273% using Kayak would again lead to additional costs for using Kayak, compared to DTS.

2. Cancellation Sensitivity Analysis

Sensitivity analysis in Table 6 hypothesizes cost savings if nonrefundable tickets were purchased and subsequently cancelled. DTS tickets are fully refundable, whereas the Carrier and Kayak tickets will not be refunded and reduce savings for using these purchasing methods.

Table 6. DTS vs Carrier/Kayak Cancellation Sensitivity Analysis

Total Costs Traveling w/in	DTS vs Carrier/Kayak Cancellation Sensitivity Analysis								
	DTS			Carrier NonRefundable			Kayak		
	0%	26%	39%	0%	26%	39%	0%	26%	39%
7 Days or Less	\$10,332	\$7,666	\$6,344	\$11,815	\$11,815	\$11,815	\$9,047	\$9,047	\$9,047
DTS Diff				(\$1,483)	(\$4,148)	(\$5,471)	\$1,285	(\$1,380)	(\$2,703)
8 to 14 Days	\$15,915	\$11,809	\$9,772	\$12,828	\$12,828	\$12,828	\$10,373	\$10,373	\$10,373
DTS Diff				\$3,086	(\$1,020)	(\$3,057)	\$5,542	\$1,436	(\$601)
15 to 30 Days	\$33,873	\$25,134	\$20,798	\$24,199	\$24,199	\$24,199	\$20,267	\$20,267	\$20,267
DTS Diff				\$9,674	\$935	(\$3,401)	\$13,607	\$4,868	\$532
> 30 Days	\$27,638	\$20,508	\$16,970	\$16,275	\$16,275	\$16,275	\$14,196	\$14,196	\$14,196
DTS Diff				\$11,363	\$4,233	\$695	\$13,442	\$6,311	\$2,773
TOTAL COST	\$87,758	\$65,117	\$53,884	\$65,117	\$65,117	\$65,117	\$53,882	\$53,882	\$53,882
TOTAL SAVINGS				\$22,641	(\$0)	(\$11,233)	\$33,876	\$11,234	\$1
ANNUALIZED SAVINGS				\$181,130	(\$3)	(\$89,867)	\$271,007	\$89,874	\$10

Cancellation sensitivity analysis in this instance considers all cancelled nonrefundable tickets as a total loss. This analysis does not consider that some cancellations may not be a total loss, since some OTAs issue credits for cancelled tickets that can be used towards future travel. For instance, if a traveler has \$500 credit and needs to purchase a ticket for \$1,000, the new ticket would cost \$500, plus an additional \$100 change fee, for a net of \$600.

For carrier nonrefundable tickets, sensitivity analysis indicates, 26% of purchased tickets would have to cancel before the cost-benefit of using carrier OTAs is drops to \$0. If more than 26% of tickets are cancelled, the use of carrier nonrefundable tickets results in a loss, compared to DTS. For instance, at 39% cancelled tickets, carrier nonrefundable tickets cost an additional \$89,867. For Kayak purchased tickets, since Kayak nonrefundable tickets are on average less expensive than carrier nonrefundable tickets,

39% of Kayak tickets would have to be cancelled to offset the benefit of using this OTA source. Cancellation rates exceeding 39% using Kayak would again lead to additional costs for using Kayak, compared to DTS.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This study's conclusions highlight the following findings:

- DTS is cheaper than carrier refundable tickets
- DTS is more expensive than carrier and Kayak nonrefundable tickets
- DTS is more expensive than nonrefundable tickets, unless a very high percentage of nonrefundable tickets are changed
- DTS is more expensive than nonrefundable tickets, unless a very high percentage of nonrefundable tickets are cancelled

To address study research questions, data analysis concludes that prices of airline tickets purchased for NPS traveler mission requirements are significantly different from comparable tickets available from carrier or Kayak websites. More specifically, DTS refundable ticket costs are less expensive than carrier refundable tickets costs. Therefore, if NPS travelers require a refundable ticket, they should only book using DTS. Conversely, findings show that DTS refundable tickets are more expensive than carrier and Kayak OTA nonrefundable tickets. If NPS travelers do not require refundable tickets, nonrefundable carrier and Kayak OTA tickets are demonstrated to produce cost savings, with Kayak OTA tickets resulting in the greatest savings of these two options.

Additionally, to address the question of lead-time from ticket purchase to travel departure, this study finds that the number of days between purchase date and departure date is not a factor when comparing DTS refundable ticket costs and carrier refundable tickets costs, as DTS is always less expensive. However, the number of days between purchase date and departure date plays a role in the price of ticket cost comparison between DTS refundable tickets and carrier and OTA nonrefundable tickets, as DTS is more expensive in most cases. This leads to sensitivity analysis to determine how often tickets must be changed or cancelled to offset cost-savings benefits for using these options.

Sensitivity analysis conducted shows cost savings are achievable using carrier and OTA nonrefundable tickets instead of DTS refundable tickets, even when change and cancellation fees apply to the nonrefundable tickets. For example, when looking at change fee costs for non DTS options, each carrier nonrefundable ticket would have to be changed 1.83 times before reaching the cost of purchasing tickets with DTS. For Kayak OTA purchases, average changes per ticket would have to increase even further to 2.73. If actual average changes per ticket are less, savings can be achieved using these methods instead of DTS. Similarly, for ticket cancellations, 26% of carrier nonrefundable and 39% of Kayak OTA tickets must be cancelled to offset benefits for using these sources. If ticket change and cancellation frequencies are determined to be higher than these rates, then it is more beneficial to use DTS for ticket purchases.

Per the JFTR/JTR, current DoD policy states that while on official business, government travelers are required to use GSA city-pair contract carriers, unless a specific exception applies. Travelers are required to use contract carriers because airline participation incentives are based on volume, giving airlines the business volume needed to offer discounted rates. The GSA city-pair program, imbedded in DTS, has several advantages, including no advance purchase required, refundable tickets, and no fee for cancellations or changes. However, an exception to the policy allows government travelers to take advantage of other low commercial fares offered by non-contract carriers. Travelers using non-contracted carriers with lower fares must also take into account the restrictions such as nonrefundability and change or cancellation fees. This study shows the flexibility achieved through DTS refundable tickets available in the city-pair program comes with a cost; which is the potential savings that could be achieved by using nonrefundable tickets. Annualized, potential savings at NPS could amount as much as \$271,007 if there are no itinerary changes or cancellations.

B. RECOMMENDATIONS

1. Future Study Recommendations

The following recommendations are suggested to increase the scope of future analyses:

- Conduct additional studies at operational bases and across services to validate results found in this study
- Include all travel in future studies, not just routine travel, to provide a better picture of the operational environment
- Compare exact flight data instead of flights available in a window (used in this study) or reduce the flight window for comparison (for example, reduce the flight window from four hours to two hours), to more closely mirror traveler mission requirements
- Conduct future studies for longer time periods, not just the 45 day summer period used in this study. These future studies will validate this study or determine if results in this study is influenced by seasonal price variations. These studies will also provide stronger data for determining annualized savings or losses when comparing refundable and nonrefundable tickets.

2. Policy Recommendations

DoD should implement the following actions in the short-term:

- DoD needs to track ticket change and cancellation frequencies to validate the need for refundable tickets and the added expense for these tickets. This would help determine a breakeven point for determining when refundable tickets are more economical than nonrefundable tickets.
- Change policy to direct nonrefundable tickets as the first choice for TDY travel. Allow travelers and management flexibility for deciding if travelers require refundable tickets. This decision should be based on the

anticipated likelihood of mission changes leading to itinerary changes or cancellations. If the probability of itinerary travel changes is anticipated as high, refundable tickets should be purchased at the extra expense.

DoD should consider the following for long-term policy changes:

- Based on DoD implementation of nonrefundable ticket use as the first choice for TDY travel, as suggested above, implement a DTS upgrade that allow travelers visibility to nonrefundable tickets. Travelers can then weigh the likelihood of itinerary changes and cancellations, as well as potential price saving information when determining if purchased TDY tickets should be refundable or nonrefundable.
- DoD should assess the need of the city-pair program. If it is more economical to purchase nonrefundable tickets and future studies determine travel change and cancellation frequencies do not offset savings for nonrefundable ticket use, the city-pair program should be cancelled.

VII. ADDITIONAL INFORMATION SOURCES

A. ON-LINE AVAILABLE RESOURCES

- DoD Travel Policy
 - Perdiem, Travel and Transportation Allowance website - <http://perdiem.hqda.pentagon.mil/perdiem/trvlregs.html>
 - DoD Travel Regulations - <http://perdiem.hqda.pentagon.mil/perdiem/trvlregs.html>
- DTS Website - www.defensetravel.osd.mil
- Online Travel Agent/Carrier Websites
 - American Airlines – www.AA.com
 - Alaska Airlines – www.Alaskaair.com
 - Cheaptickets – www.Cheaptickets.com
 - Continental Airlines – www.Continental.com
 - Delta Airlines - www.Delta.com
 - Frontier Airlines – www.Frontierairlines.com
 - Great Lakes Aviation – www.Greatlakesav.com
 - Orbitz – www.Orbitz.com
 - United Airlines – www.United.com
 - Express Jet – www.Xjet.com
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